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10/686,817	10/17/2003	Yoshifumi Arai	Q77855	8793

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SUGHRUE MION, PLLC
2100 PENNSYLVANIA AVENUE, N.W.
SUITE 800
WASHINGTON, DC 20037

EXAMINER	
CHENG, PETER L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/686,817	ARAI, YOSHIFUMI
	Examiner	Art Unit
	PETER L. CHENG	2625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 January 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9,11,12 and 18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,11,12 and 18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *6/28/2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to because:

- **Fig. 12:** as with **page 68, line 26** [of the marked-up specification], it is suggested the word **Treble** be changed to **Triple**, or **Tripled**;

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

1. The disclosure is objected to because of the following informalities:
   Please note that the following page/line numbers refer to the marked-up specification.
   - Recommend correcting the following typographical or grammatical errors in the disclosure; for example, **page 2 line 14; page 9, line 23; page 22, line 9; page 25, line 1; page 50, line 26 (**remove ":"**); page 9, line 20 (**as with page 9, line 20, replace "1," with "1",**); page 22, line 6 (**as with page 22, line 10, replace "1," with "1",**); page 32, line 14 (**replace "grasped" with "determined", or similar wording**); page 35, line 27 (**replace "part of high" with "part of the high"**); page 39, lines 19- 20 (**replace "to be" with "are"**); page 43, lines 19-22 (**remove ":" after "because" and rephrase**); page 57, line 5 (**replace "is" with "are"**); page 64, line 23 (**replace "grasps" with "determines", or similar wording**); page 77, line 10 (**replace "acquired" with "acquires", or similar wording**); page 78, line 28 (**replace "grasps" with "determines", or similar wording**); page 80, line 7 (**replace "3." with "3".**);**

- **page 10, lines 21, 22, 24, 26; page 15, line 6; page 32, line 13:** as with the description on **page 8, lines 15-19,** since an unsigned 8-bit value has 256 integral values from **0** to 255, suggest replacing **256** with **255**;

- **page 15, lines 14 - 15:** please rewrite the sentence containing **cannot be indefinitely *considered***; it is assumed that applicant intended to cite "**... a deviation equivalent to the fractional portion ... cannot be indefinitely *ignored***", or similar wording;

- **page 20, line 19; page 41, line 12:** suggest **a print operation** instead of **print operation**;

- **page 32, line 22:** please rewrite the sentence containing **cannot be indefinitely *considered***; it is assumed that applicant intended to cite "**... a deviation equivalent to the fractional portion ... cannot be indefinitely *ignored***", or similar wording;

- **Page 51, lines 21 - 23:** for clarity, please rewrite the phrase, **a smaller value in CMYKlclm data after color separation does not necessarily <u>*more greatly vary*</u> between before and after [gamma] correction**;

- **Page 52, lines 16 - 17:** per **Fig. 6**, the "first gradation value data" [3rd table from the left] results from "color separation"; for clarity, please rewrite the sentence, **Accordingly, only <u>data after color separation</u> *does not correspond* to the first gradation value data**; this appears to contradict what is illustrated in **Fig. 6**; it is assumed that applicant intended to cite, **Accordingly, data other than "data after color separation" may correspond to the first gradation value data**, or similar wording;

- **Page 66, line 27:** as shown in **Fig. 6**, data obtained by carrying out color separation [i.e., 3rd table from the left] is then subjected to *gamma correction for resolution enhancement*; for clarity, it is assumed that applicant intended to cite **resolution enhancement** instead of **interpolation accuracy enhancement**;

- **Page 74, lines 23 - 25:** for clarity, please rewrite the phrase **a smaller value in CMYKlclm data after color separation does not necessarily <u>*more greatly vary*</u> between before and after [gamma] correction**;

- **Page 74, lines 25 - 28:** for clarity, please rewrite the phrase **a smaller value in CMYKlclm data will <u>*more greatly vary*</u> between before and after [gamma] correction**;

Appropriate correction is required.

Claim Objections

2. Claim 3 is objected to because of the following informalities:
    - **Page 6, line 18:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** (*or* "one step variation") instead of **"one-step variation"**;

3. Claim 7 is objected to because of the following informalities:
    - **Page 10, line 5:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

4. Claim 8 is objected to because of the following informalities:
    - **Page 11, line 8:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;
    - **Page 11, line 13:** **"the result of the print operation"** lacks antecedent basis; it is assumed that applicant intended to cite **"a result of the print operation"**;

- **Page 11, line 18:** with reference to **page 11, line 13**, it is assumed that **"a result of the print operation"** should instead cite **"the result of the print operation"**;

5. Claim 9 is objected to because of the following informalities:

   - **Page 12, line 25:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

   - **Page 13, line 4: "the result of the print operation"** lacks antecedent basis; it is assumed that applicant intended to cite **"a result of the print operation"**;

   - **Page 13, line 9:** with reference to **page 13, line 14**, it is assumed that **"a result of the print operation"** should instead cite **"the result of the print operation"**;

6. Claim 11 is objected to because of the following informalities:

   - **Page 14, lines 3 - 4: "the total number of gradations"** lacks antecedent basis; as with claim 1, it is assumed that applicant intended to cite **"a total number of gradations"**;

- **Page 14, line 20:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

7. Claim 12 is objected to because of the following informalities:
   - **Page 15, line 10:** with reference to **page 14, lines 3 - 4**, and as with claim 2, it is assumed that **"a total number of gradations"** should instead cite **"the total number of gradations"**;

8. Claim 18 is objected to because of the following informalities:
   - **Page 16, line 18:** as with claim 1, it is assumed that applicant intended to cite **"one step-variation"** instead of **"one-step variation"**;

Appropriate correction is required.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

   (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

11. Claims 1 - 6, 8, 9, and 11 - 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **JACOBS [US Patent 5,481,655]** in view of **MAHY [6,575,095 B1]**.

As for claim 1, JACOBS teaches a color conversion table generating method wherein a plurality of patches outputted from a printing device **[Fig. 2** color patches **32]** are subjected to color measuring **[Fig. 2** spectrophotometer **36]** and a color conversion table **[Fig. 6** custom ink table **74]** which defines ~~the~~ a correspondence between ~~the~~ color component values of various colors used in another image device **[Fig. 6** monitor model **22]** and ink value data corresponding to ~~the~~ ink quantities of inks in individual ink colors used in the printing device **[Fig. 6** master ink table **70]** is generated based on ~~the~~ a result of the color measuring, the method comprising:

> **~~a step for~~ extracting a ~~smaller~~ number of reference smaller values than ~~the~~ a total number of gradations in said ink value data with respect to each ink color and combining ~~them~~ the reference values thereby to create patch data which specifies ~~a~~ said plurality of ~~said~~ patches**

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ <u>input</u> and transformed into half tone image data which indicates ~~the~~ <u>a</u> presence or absence of ink dots to print ~~a~~ <u>said</u> plurality of ~~said~~ patches;

and ~~a step for~~ generating said color conversion table based on color measuring data obtained by subjecting ~~a~~ <u>said</u> plurality of ~~the~~ printed patches to color measuring

["a spectrophotometer 36 ... is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51],**

wherein the colors in said patch data are colors obtained by extracting a ~~smaller~~ number of reference values *before correction* <u>smaller</u> than the total number of gradations in predetermined gradation values *before correction*<u>,</u> from the gradation values *before correction*<u>,</u> with respect to each ink color and combining the reference values *before correction*

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32. As is known in

the art, the ink values typically have the intensity values of grid points 33 (FIG. 3A) on a three-dimensional grid 34 and there is one ink value for each grid point 33"; **col. 5, lines 33 - 39],**

carrying out <u>correction for interpolation accuracy enhancement</u> to increase the reference values before correction, and thereby bringing the magnitude of values after the correction and the ink quantity into substantially linear correspondence with each other;

wherein said <u>ink value data</u> is defined so that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in ~~the~~ <u>an</u> ink recording rate corresponding to ~~the~~ <u>a</u> unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range;

and wherein <u>in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented,</u>

<u>and</u> ~~in said halftone processing,~~ ink quantities corresponding to the reference values in said patch data are <u>interpreted</u> according to ~~the~~ <u>a</u> definition of the

gradation values, while keeping the subtle variation which is substantially equivalent to the fractional portion, to generate said halftone image data.

However, JACOBS does not teach

~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ input and transformed into half tone image data which indicates ~~the~~ a presence or absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches;

carrying out correction for interpolation accuracy enhancement to increase the reference values before correction, and thereby bringing the magnitude of values after the correction and the ink quantity into substantially linear correspondence with each other;

wherein said ink value data is defined so that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in ~~the~~ an ink recording rate corresponding to ~~the~~ a unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range;

and wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area and one step-variation in gradation results in a large number of steps in dot variation, thus subtle

> **variation which is substantially equivalent to a fractional portion is represented,**
>
> **and ~~in said halftone processing,~~ ink quantities corresponding to the reference values in said patch data are interpreted according to ~~the~~ a definition of the gradation values, while keeping the subtle variation which is substantially equivalent to the fractional portion, to generate said halftone image data.**

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ input and transformed into half tone image data which indicates ~~the~~ a presence or absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches [Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

carrying out <u>correction for interpolation accuracy enhancement</u> to increase the reference values before correction, and thereby bringing the magnitude of values after the correction and the ink quantity into substantially linear correspondence with each other

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (**LUT**) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**];**

wherein said <u>ink value data</u> is defined so that a gradation value which is an integral value existing in a predetermined range of value and corresponds to a higher-lightness range will be reduced in ~~the~~ <u>an</u> ink recording rate

corresponding to ~~the~~ a unit variation in that gradation value as compared with gradation values corresponding to a lower-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

and wherein <u>in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing*. The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because

in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value"**]**

<u>and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented</u>

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of <u>12%</u>. When c_K is in the range of

20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour... This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, ..."; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"]**,**

and ~~in said halftone processing,~~ ink quantities corresponding to the reference values in said patch data are interpreted according to ~~the~~ a definition of the gradation values, while keeping the subtle variation which

is substantially equivalent to the fractional portion, to generate said halftone image data

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 2, MAHY further teaches the color conversion table generating method according to Claim 1, wherein

said ink value data is defined by allocating the total number of gradations to part of the range of ~~value~~ values of said ink recording rate

[With respect to Fig. 8, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30.** In this case, MAHY teaches that the tone values above A% can be ignored

(or "clipped"). "The advantage of the clipping operation is that the average spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation"; **col. 24, lines 44 - 47].**

As for claim 3, JACOBS teaches a color conversion table generating method for generating a color conversion table which defines ~~the~~ a correspondence between ink value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the method comprising:

~~a step for~~ extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a magnitude of ~~the~~ gradation values are in substantially linear correspondence with each other with respect to each ink color and combining ~~them~~ the gradation values to create first gradation value data;

~~a step for~~ subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range, to obtain said ink value data;

~~a step for~~ performing halftone processing, wherein gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation

which is substantially equivalent to a fractional portion is represented, and in said half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation;

and ~~a step for~~ generating a color conversion table where said ink value data and ~~the~~ color component values of various colors used in said another image device are in correspondence with each other based on color measuring data [using a spectrophotometer **36** as shown in **Fig. 2] obtained by subjecting the result of the print operation to color measuring [Fig. 6** custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**];**

wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

However, JACOBS does not teach

> **~~a step for~~ extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a magnitude of ~~the~~ gradation values are in substantially linear correspondence with each other with respect to each ink color and combining ~~them~~ the gradation values to create first gradation value data;**

> **~~a step for~~ subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range, to obtain said ink value data;**

> **~~a step for~~ performing halftone processing, wherein gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented,**

> **and in said half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation;**

> **wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.**

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **~~a step for~~ extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a magnitude of ~~the~~ gradation values are in substantially linear correspondence with each other with respect to each ink color and combining ~~them~~ the gradation values to create first gradation value data [Fig. 4** calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table **(LUT)** attempts to linearize the response (i.e., the

“lightness”, L* which correlates with an “ink quantity”) with colorant value (i.e., c_K which corresponds to a gradation reference value);

“first gradation value data” corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**;

~~a step for~~ subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range, to obtain said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the “ink mixing table” **31** and also shown in **Fig. 6**. “Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate”; **col. 22, lines 2 – 8.** With respect to the “dark cyan” tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness

range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

~~a step for~~ performing halftone processing, <u>wherein gradations are represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing.* The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value"**]<u>,</u>**

<u>and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented</u>

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"**],**

and in said half tone processing, taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

wherein, said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table **(LUT)** attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 4, MAHY further teaches the color conversion table generating method according to Claim 3, wherein

the gradation values in said <u>first gradation value data</u> are created based on data obtained by transforming coordinates in a predetermined color space constituted of a smaller number of color components than ~~the~~ <u>a</u> number of ink colors into gradation values which indicate the quantities of individual color inks by a predetermined transformation expression

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** The "predetermined transformation expression" corresponds to the "mixing table"**].**

As for claim 5, MAHY further teaches the color conversion table generating method according to Claim 3, wherein

the gradation values in said <u>first gradation value data</u> are obtained by subjecting gradation values where the ink quantity and the magnitude of gradation values are in substantially linear correspondence with each other to [gamma] correction where a smaller gradation value is corrected with a higher rate of increase as compared with larger gradation values and ~~the~~ <u>a</u> result of the correction is outputted

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the

corresponding lookup table (**LUT**) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**.

MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). In this example, MAHY illustrates that smaller gradation values are corrected with a higher rate of increase as compared to larger gradation values; for example, when c_K (in table column 3) is 10%, the output of the **LUT** (in table column 5) is 20%; this corresponds to a doubling (or increase of 100%) in tone value; however, when the colorant value c_K is 80%, the output of the LUT is %74; this difference corresponds to just a 7.5% change**]**.

As for claim 6, MAHY further teaches the color conversion table generating method according to Claim 3, wherein

a gradation value which indicates the lowest lightness in said <u>first gradation value data</u> is equivalent to ~~the~~ <u>a</u> highest ink recording rate at which the ink can be recorded on a printing medium

[This gradation value corresponds to point **A%** in **Fig. 8];**

and in said <u>correction for resolution enhancement</u>, a predetermined gradation value range containing the gradation value which indicates the lowest lightness is excluded and the correction is carried out so that the remaining gradation value range will be matched with the whole gradation value range of said ink value data

[With respect to **Fig. 8**, MAHY teaches a case when “there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%”; **col. 24, lines 27 – 30**. In this case, MAHY teaches that the tone values above A% can be ignored (or “clipped”). “The advantage of the clipping operation is that the average spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation”; **col. 24, lines 44 - 47].**

As for claim 8, JACOBS teaches a color conversion table generator which generates a color conversion table which defines ~~the~~ <u>a</u> correspondence between ink value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, the generator ~~comprise~~ <u>comprising</u>:

a first gradation value data acquiring unit ~~for acquiring~~ <u>that acquires</u> first gradation value data obtained by extracting gradation values where ~~the~~ <u>an</u> ink quantity and ~~the~~ <u>a</u> magnitude of gradation values are in substantially linear

correspondence with each other with respect to each ink color and combining the gradation values;

an ink value data acquiring unit ~~for subjecting~~ that subjects the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range, to acquire ~~the~~ a result of the correction as said ink value data;

a print operation performing unit ~~for performing~~ that performs halftone processing, wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented, said print operation performing unit taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation;

a print result color measuring unit ~~for subjecting~~ that subjects ~~the~~ a result of the print operation to color measuring

["a spectrophotometer 36 … is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and a color conversion table generating unit ~~for generating~~ <u>that generates</u> a color conversion table where said ink value data and the color component values of various colors used in said another image device are <u>in</u> correspondence with each other based on color measuring data obtained by subjecting *the* result of the print operation to color measuring [Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**],**

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

However, JACOBS does not teach

a first gradation value data acquiring unit ~~for acquiring~~ that acquires first gradation value data obtained by extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values;

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a print operation performing unit ~~for performing~~ that performs halftone processing, wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented, said print operation performing unit taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation;

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

a first gradation value data acquiring unit ~~for acquiring~~ <u>that acquires</u> first gradation value data obtained by extracting gradation values where ~~the~~ <u>an</u> ink quantity and ~~the~~ <u>a</u> magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table **(LUT)** attempts to linearize the response (i.e., the

"lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**;

an ink value data acquiring unit ~~for subjecting~~ <u>that subjects</u> the <u>first gradation value data</u> to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ <u>high</u>-lightness range than to gradation values corresponding to a ~~lower~~ <u>low</u>-lightness range<u>,</u> to acquire ~~the~~ <u>a</u> result of the correction as said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-

lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

a print operation performing unit ~~for performing~~ <u>that performs</u> halftone processing, <u>wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing.* The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value"**]**

and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented

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Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"**],**

said print operation performing unit taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement to perform a print operation

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 9, JACOBS teaches a <u>computer-readable </u>medium with a color conversion table generating program recorded thereon ~~for~~ <u>to have a computer carry out a method for </u>generating a color conversion table which defines ~~the~~ <u>a </u>correspondence between ink value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors

used in another image device **[Fig. 6** monitor model **22]**, ~~wherein the program causes a computer to carry out~~ the method comprising:

~~a first gradation value data acquiring function of~~ acquiring first gradation value data obtained by extracting gradation values where ~~the~~ an ink quantity and ~~the~~ a magnitude of the gradation values are in substantially linear correspondence with each other with respect to each ink color and combining the gradation values;

~~an ink value data acquiring function of~~ subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range and acquiring ~~the~~ a result of the correction as said ink value data;

~~a print operation performing function of~~ performing half tone processing, wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented, said half tone processing taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement, and performing a print operation;

~~a print result color measuring function of~~ subjecting ~~the~~ a result of the print operation to color measuring

["a spectrophotometer 36 … is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

and ~~a color conversion table generating function of~~ generating a color conversion table where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other based on color measuring data obtained by subjecting ~~the~~ a result of the print operation to color measuring

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**];**

wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy.

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> **~~an ink value data acquiring function of~~ subjecting the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range and acquiring ~~the~~ a result of the correction as said ink value data;**

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subjected to correction inverse to said correction for resolution enhancement, and performing a print operation;

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black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

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lines 2 – 8. With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

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Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, “That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"**],**

said half tone processing taking into account deviations equivalent to fractional portions obtained when the ink value data is subjected to correction inverse to said correction for resolution enhancement, and performing a print operation

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wherein said first gradation value data is extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively

degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 11, JACOBS teaches a <u>correspondence definition data</u> **[**i.e., a color conversion table**]** creating method wherein plurality of patches outputted from a printing device **[Fig. 2** color patches **32]** are subjected to color measuring **[Fig. 2**

spectrophotometer **36]**, and correspondence definition data **[Fig. 6** custom ink table **74]** which defines ~~the~~ a correspondence between ~~the~~ color component values of various colors used in another image device **[Fig. 6** monitor model **22]** and gradation values corresponding to ~~the~~ ink quantities of inks in individual colors used in the printing device **[Fig. 6** master ink table **70]** is created based on ~~the~~ a result of the color measuring, the method comprising:

~~a step for~~ extracting a ~~smaller~~ number of reference values smaller than ~~the~~ a total number of gradations in gradation values corresponding to said ink quantities with ~~respected~~ respect to each ink color and combining ~~them~~ the reference values thereby to create patch data which specifies ~~a~~ said plurality of ~~said~~ patches

["The printing device 12 receives a plurality of stepped ink values, such as CMY values, thereby to produce a collection 30 of color patches 32"; **col. 5, lines 33 - 36];**

~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ input and transformed into halftone image data which indicates ~~the~~ a presence or absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches;

and ~~a step for~~ creating said correspondence definition data based on color measuring data obtained by subjecting ~~a~~ said plurality of ~~the~~ printed patches to color measuring

["a spectrophotometer 36 … is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51]**,

wherein gradation values corresponding to said ink quantities are so defined that a gradation value which is an integral value existing in a predetermined range of ~~value~~ values and corresponds to a ~~higher~~ high-lightness range will be reduced in ~~the~~ an ink recording rate corresponding to ~~the~~ a unit variation in that gradation value as compared with gradation values corresponding to a ~~lower~~ low-lightness range;

and wherein in said halftone processing, gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented, and ink quantities corresponding to reference values in said patch data are interpreted according to ~~the~~ a definition of the gradation values, while keeping the subtle variation which is substantially equivalent to the fractional portion, to generate said half tone image data.

However, JACOBS does not teach

~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ input and transformed into halftone image data which indicates ~~the~~ a presence or absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches;

wherein gradation values corresponding to said ink quantities are so defined that a gradation value which is an integral value existing in a predetermined range of ~~value~~ values and corresponds to a ~~higher~~ high-lightness range will be reduced in ~~the~~ an ink recording rate corresponding to ~~the~~ a unit variation in that gradation value as compared with gradation values corresponding to a ~~lower~~ low-lightness range;

and wherein in said halftone processing, gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented, and ink quantities corresponding to reference values in said patch data are interpreted according to ~~the~~ a definition of the gradation values, while keeping the subtle variation which is substantially equivalent to the fractional portion, to generate said half tone image data.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the

left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates

> **~~a step for~~ performing halftone processing where the patch data is ~~inputted~~ input and transformed into halftone image data which indicates ~~the~~ a presence or absence of ink dots to print ~~a~~ said plurality of ~~said~~ patches [Fig. 5** "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**
>
> From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**];**
>
> **wherein gradation values corresponding to said ink quantities are so defined that a gradation value which is an integral value existing in a predetermined range of ~~value~~ values and corresponds to a ~~higher~~ high-lightness range will be reduced in ~~the~~ an ink recording rate corresponding to ~~the~~ a unit variation in that gradation value as compared with gradation values corresponding to a ~~lower~~ low-lightness range**

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

and wherein in said halftone processing, <u>gradations are represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing*. The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the

same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value"**]**,

and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"**],**

and ink quantities corresponding to reference values in said patch data are interpreted according to ~~the~~ a definition of the gradation values, while keeping the subtle variation which is substantially equivalent to the fractional portion, to generate said half tone image data

[From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of JACOBS with those of MAHY to enable one to generate *correspondence definition data* so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation.

As for claim 12, MAHY further teaches the correspondence definition data creating method according to Claim 11, wherein

said gradation values corresponding to ink quantities are defined by allocating *the* total number of gradations to part of the range of value of ink recording rate

[With respect to **Fig. 8**, MAHY teaches a case when "there are almost no colour differences between the patches of a wedge in a specific tone value interval, usually an interval from a specific tone value A% to 100%"; **col. 24, lines 27 – 30**. In this case, MAHY teaches that the tone values above A% can be ignored (or "clipped"). "The advantage of the clipping operation is that the average

spacing between the t-levels in the interval from 0% to A% may be smaller, which results in more accurate colour representation"; **col. 24, lines 44 - 47].**

12. Claims 7, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over **JACOBS [US Patent 5,481,655]** in view of **MAHY [6,575,095 B1]** and **KAKUTANI [US Patent 6,439,682 B1]**.

As for claim 7, JACOBS teaches a print controller which refers to a color conversion table **[Fig. 6** custom ink table **74]** which defines ~~the~~ a correspondence between ink value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, and creates print data which indicates output images on the printing device from image data which indicates display images on the image device and causes a print operation to be performed, the controller ~~comprises~~ comprising:

an image data acquiring unit ~~for acquiring~~ that acquires image data where ~~the~~ a color at each pixel in a matrix pattern is rendered with gradations with respect to images on said another image device

[Fig. 1 "image in monitor color space" **10** acquires the image data which is displayed on a monitor; "Image 10 is typically provided from the user in a first coordinate system, such as any suitable RGB coordinate system"; **col. 4, lines 41 - 43];**

a color converting unit which extracts gradation values

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".**]**

where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combines the gradation values to create first gradation value data,

subjects the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range to obtain said ink value data,

subjects the ink value data to halftone processing, taking into account deviations equivalent to fractional portions obtained when correction inverse to said correction for resolution enhancement is carried out, and performs the print operation~~,~~;

a color conversion table generating unit that generates a color conversion table where said ink value data and the color component values of various colors used in said another image device are in correspondence with each other based on color measuring data [using a spectrophotometer **36** as shown in **Fig. 2] obtained by subjecting the result of the print operation to color measuring**

[Fig. 6 custom table builder **72** produces a "custom ink table" **74** by bringing colors indicated by combinations of input gradation values (i.e., the "master ink table" **70** of the printer) and colors indicated by combinations of said color component values (i.e., the monitor model **22**) into correspondence with each other**],**

said first gradation value data being extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy,

and said color converting unit refers to the thus generated color conversion table to color-convert said image data into corresponding ink value data

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 - 21];**

a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the ink quantities into pseudo half-tone data where gradations are represented by ~~the~~ a recording density of ink droplets recorded on a printing medium, wherein said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented;

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel;

and a print data outputting unit ~~for outputting~~ that outputs the print data to the printing device.

However, JACOBS does not teach

where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in substantially linear correspondence with each other with respect to each

ink color and combines the gradation values to create first gradation value data,

subjects the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range to obtain said ink value data,

subjects the ink value data to halftone processing, taking into account deviations equivalent to fractional portions obtained when correction inverse to said correction for resolution enhancement is carried out, and performs the print operation~~,~~;

said first gradation value data being extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy,

a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the

ink quantities into pseudo half-tone data where gradations are represented by ~~the~~ a recording density of ink droplets recorded on a printing medium,

wherein said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented;

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel;

and a print data outputting unit ~~for outputting~~ that outputs the print data to the printing device.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates a process for creating calibration tables

where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in substantially linear correspondence with each other with respect to each ink color and combines the gradation values to create first gradation value data

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (LUT) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**],**

subjects the first gradation value data to correction for resolution enhancement with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range to obtain said ink value data

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that

transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69],**

subjects the ink value data to halftone processing, taking into account deviations equivalent to fractional portions obtained when correction inverse to said correction for resolution enhancement is carried out, and performs the print operation
[Fig. 5 "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**]**~~,~~;

said first gradation value data being extracted beforehand so that colors in the low-lightness range will be larger in number than colors in the high-lightness range so as to compensate the resolution which is relatively degraded in the low-lightness range by said correction for resolution enhancement by interpolation accuracy

[Fig. 4 calibration curves 45, 46, 47, 48 corresponding to cyan, magenta, yellow, and black, respectively**; TABLE 1** in **cols. 16** and **17** illustrates curve **48** (for black) and the relation between colorant value, c_K and tone value t_K; the corresponding lookup table (**LUT**) attempts to linearize the response (i.e., the "lightness", L* which correlates with an "ink quantity") with colorant value (i.e., c_K which corresponds to a gradation reference value);

"first gradation value data" corresponds to the conversion of colorant values (e.g., c_K) to tone values (e.g., t_K)**]**,

a halftone processing unit for interpreting ink quantities indicated by the ink value data from the color-converted ink value data and transforming the ink quantities into pseudo half-tone data where gradations are represented by ~~the~~ a recording density of ink droplets recorded on a printing medium

[Fig. 5 "screening LUT's" **66, 67, 68, 69** and "screening algorithms" **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by "screening LUT's" **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by "screening algorithms" **61, 62, 63, 64** to produce halftone image data**],**

<u>wherein said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area</u>

[MAHY teaches that "*the invention may be applied to ink-jet printing.* The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value"**],**

<u>and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented</u>

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of <u>12%</u>. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of <u>5%</u>.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening

technique that are used, *the number of bits that are used to represent a colour in different stages of the process*, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"**];**

KAKUTANI teaches a printing method and a printing apparatus. As shown in **Fig. 2**, the data from the "halftone module" **99** is sent to a "rasterizer" **100** which, in turn, sends data to the "printer" **22.** KAKUTANI teaches

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half-tone data with respect to each pixel **[**KAKUTANI cites, "The halftone module 99 creates dots in a dispersing manner and thereby implements the halftone processing, which enables the printer 22 to express the tone values. The *rasterizer 100 sorts the processed image data out in the sequence of data to be transferred to the printer* 22 and *outputs the sorted data as final print data FNL*"; **col. 14, lines 50 – 56.** The "rasterizer" corresponds to the "print data creating unit"**];**

and a print data outputting unit ~~for outputting~~ that outputs the print data to the printing device

[As noted above, the “rasterizer” also outputs the print data to a printer**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of KAKUTANI and JACOBS with those of MAHY in order to implement a print controller which utilized a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation and KAKUTANI teaches the concept of preparing the halftoned print data in a format usable by the printer.

As for claim 18, JACOBS teaches a print controller which refers to a correspondence definition data **[**i.e., a color conversion table; **Fig. 6** custom ink table **74]** which defines ~~the~~ a correspondence between ink value data which specifies ~~the~~ ink quantities of inks in individual colors used in a printing device **[Fig. 6** master ink table **70]** and ~~the~~ color component values of various colors used in another image device **[Fig. 6** monitor model **22]**, and creates print data which indicates output images on the printing device from image data which indicates display images on the image device and causes a print operation to be performed, the controller comprising:

an image data acquiring unit ~~for acquiring~~ that acquires image data where the color at each pixel in a matrix pattern is rendered with gradations with respect to images on said another image device

[Fig. 1 "image in monitor color space" **10** acquires the image data which is displayed on a monitor; "Image 10 is typically provided from the user in a first coordinate system, such as any suitable RGB coordinate system"; **col. 4, lines 41 - 43];**

a color converting unit which performs a print operation with a plurality of pieces of ink value data which specify said ink quantities of inks in individual colors

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".**],**

obtained by correcting first gradation value data where ~~the~~ *an ink quantity and* ~~the~~ *a magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a* ~~higher~~ *high-lightness range than to gradation values corresponding to a* ~~lower~~ *low-lightness range;*

refers to correspondence definition data where said ink value data and ~~the~~ color component values of various colors used in said another image device are in correspondence with each other

["The custom ink table 74 comprises a plurality of output ink values corresponding to a plurality of input RGB coordinates"; **col. 7, lines 19 – 21.** The input to this table consists of image data gradation values for the "another image device".**],**

based on color measuring data obtained by subjecting ~~the~~ a result of the print operation to color measuring and color-converts said image data into corresponding ink value data;

["a spectrophotometer 36 … is utilized to measure the color value, in the selected colorimetric color coordinate system, of each color patch 32"; **col. 5, lines 47 - 51];**

a halftone processing unit which interprets ink quantities indicated by the ink value data from the color-converted ink value data and transforms the ink quantities into pseudo half tone data where gradations are represented by ~~the~~ a recording density of ink droplets recorded on a printing medium, wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large

number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented;

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half tone data;

and a print data outputting unit which outputs the print data to the printing device.

However, JACOBS does not teach

obtained by correcting first gradation value data where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range;

a halftone processing unit which interprets ink quantities indicated by the ink value data from the color-converted ink value data and transforms the ink quantities into pseudo half tone data where gradations are represented by ~~the~~ a recording density of ink droplets recorded on a printing medium,

wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area, and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented;

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half tone data;

and a print data outputting unit which outputs the print data to the printing device.

MAHY teaches a method and an apparatus for calibrating a printing device. **Figures 4 and 5** illustrate the conversion of color data from one color space (e.g., L*a*b* on the left side of **Fig. 4**) to color data for a printer's color space (e.g., halftone or "screened") CMYK data at switches **71** and **72** in **Fig. 5**; note that **Fig. 5** only illustrates the halftone data for cyan which consists of both light and dark marking particles). In this conversion process, MAHY illustrates a process for creating calibration tables

obtained by correcting first gradation value data where ~~the~~ an ink quantity and ~~the~~ a magnitude of gradation values are in substantially linear correspondence with each other with a higher rate of increase applied to a

gradation value corresponding to a ~~higher~~ high-lightness range than to gradation values corresponding to a ~~lower~~ low-lightness range

[For a printer with both light and dark marking particles, MAHY teaches a step where a colorant tone value is separated into separate tone values for both light and dark marking particles; this is shown in **Fig. 5** as the "ink mixing table" **31** and also shown in **Fig. 6**. "Fig. 6 shows a mixing table 31 for cyan that transforms the global tone value for cyan t_C into a first value t_{C1} via curve 32 and into a second value t_{C2} via curve 33; the values t_{C1} and t_{C2} ultimately determine respectively an amount of light cyan marking particles and an amount of dark cyan marking particles that are to be applied to a receiving substrate"; **col. 22, lines 2 – 8.** With respect to the "dark cyan" tone value t_{C2}, **Fig. 6** illustrates a larger reduction in ink recording rate at lower input tone values (i.e., in the higher-lightness range) than at higher input tone values (i.e., in the lower-lightness range). **Fig. 5** further illustrates that both light and dark tone values are further calibrated by "single ink calibration curves" (i.e., gamma curves) **42, 43** which are complemented by the "screening LUT's" **66, 67, 68, 69];**

a halftone processing unit which interprets ink quantities indicated by the ink value data from the color-converted ink value data and transforms the ink quantities into pseudo half tone data where gradations are represented by ~~the~~ a recording density of ink droplets recorded on a printing medium

[Fig. 5 “screening LUT’s” **66, 67, 68, 69** and “screening algorithms” **61, 62, 63, 64;**

From **Fig. 5,** MAHY teaches that the tone values t^*_{C1} and t^*_{C2} are interpreted by “screening LUT’s” **66, 67, 68, 69** to produce t^{**}_{C1} and t^{**}_{C2}, respectively which, in turn, are processed by “screening algorithms” **61, 62, 63, 64** to produce halftone image data**],**

wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area

[MAHY teaches that “*the invention may be applied to ink-jet printing*. The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink”; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant’s remarks on **page 20, lines 4 – 5,** where applicant cites, “Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value”**],**

and one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented

[MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of 12%. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of 5%.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved

and often interrelated factors, such as the image resolution and the screening technique that are used, _*the number of bits that are used to represent a colour in different stages of the process*_, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution "fractional portion"**];**

KAKUTANI teaches a printing method and a printing apparatus. As shown in **Fig. 2**, the data from the "halftone module" **99** is sent to a "rasterizer" **100** which, in turn, sends data to the "printer" **22.** KAKUTANI teaches

a print data creating unit which creates print data for driving and causing the printing device to discharge ink droplets according to the recording density specified by said pseudo half tone data

[KAKUTANI cites, "The halftone module 99 creates dots in a dispersing manner and thereby implements the halftone processing, which enables the printer 22 to express the tone values. The _*rasterizer 100 sorts the processed image data out in the sequence of data to be transferred to the printer*_ 22 and _*outputs the sorted data as final print data FNL*_"; **col. 14, lines 50 – 56.** The "rasterizer" corresponds to the "print data creating unit"**];**

and a print data outputting unit which outputs the print data to the printing device

[As noted above, the "rasterizer" also outputs the print data to a printer**].**

It would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of KAKUTANI and JACOBS with those of MAHY in order to implement a print controller which utilized a color conversion table so that colors output on one device would match those of a given printing device. JACOBS teaches the concept of matching colors between output devices while MAHY teaches the concepts of linearizing color output response, color separation and halftoning when performing a print operation and KAKUTANI teaches the concept of preparing the halftoned print data in a format usable by the printer.

Response to Arguments

1. Applicant's arguments filed 1/10/2008 have been fully considered but they are not persuasive.

With respect to applicant's argument that MAHY does not teach

a first limitation

wherein in said half tone processing, gradations are represented by adjusting a count of dots recorded per unit area

and a second limitation wherein

one step-variation in gradation results in a large number of steps in dot variation, thus subtle variation which is substantially equivalent to a fractional portion is represented

has been considered.

In reply:

Regarding the first limitation, MAHY teaches that "*the invention may be applied to ink-jet printing*. The printing device is then an ink-jet printing device and the marking particles are liquid ink drops. The invention is especially suitable for ink-jet printing, because in ink-jet printing it is common to use a plurality of different types of inks of the same colorant hue, such as light cyan ink and dark cyan ink"; **col. 25, lines 30 – 36.**

It is well-known in the art that ink-jet printers can halftone image data by modulating the number of dots placed in a unit area of the receiving medium. This assertion is supported by applicant's remarks on **page 20, lines 4 – 5,** where applicant cites, "Rather, an ink-jet printer can change the number of dots applied to a medium per unit area to represent gradation value".

Regarding the <u>second limitation</u>, MAHY illustrates a tone calibration table (see **TABLE 1** in **cols. 16, 17**). From this table, MAHY illustrates a mapping between a colorant value, c_K to a tone value, t_K.

At lower colorant values (c_K), a one step variation in gradation results in a corresponding, larger variation in tone value (t_K) than at higher colorant values (c_K). For example, when c_K is in the range of 0% to 5%, the corresponding tone value t_K varies from 0% to 12%; a difference of <u>12%</u>. When c_K is in the range of 20% to 25%, the corresponding tone value t_K varies from 33% to 38%; a difference of <u>5%</u>.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to place more dots on the receiving medium for a one step variation at a lower colorant value than at a higher colorant value.

MAHY further cites, "That an observer sees a uniform smooth change is important because printing devices can only render a limited number of different shades of a specific colour… This number is limited because of many involved and often interrelated factors, such as the image resolution and the screening technique that are used, <u>*the number of bits that are used to represent a colour in different stages of the process*</u>, the number of levels of the halftoning process, …"; **col. 18, lines 32 – 41.**

It is well-known in the art that increasing the *number of bits that are used to represent color* allows for finer variations to be expressed which correspond to a computationally higher resolution “fractional portion”.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

- U.S. Patent 5,818,604 A [DELABASTITA et al.]
- U.S. Patent 2002/0024687 [ALLEN et al.]
- U.S. Patent 2003/0002058 A1 [COUWENHOVEN et al.]

2. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Peter L. Cheng whose telephone number is 571-270-3007. The examiner can normally be reached on MONDAY - FRIDAY, 8:30 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, King Y. Poon can be reached on 571-272-7440. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/King Y. Poon/
Supervisory Patent Examiner, Art Unit 2625

plc
April 10, 2008